

Tilburg University

The Impact of Explicit Deposit Insurance on Market Discipline

Ioannidou, V.; de Dreu, J.

Publication date:
2006

[Link to publication in Tilburg University Research Portal](#)

Citation for published version (APA):

Ioannidou, V., & de Dreu, J. (2006). *The Impact of Explicit Deposit Insurance on Market Discipline*. (CentER Discussion Paper; Vol. 2006-5). Finance.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



No. 2006–05

**THE IMPACT OF EXPLICIT DEPOSIT INSURANCE ON
MARKET DISCIPLINE**

By Vasso P. Ioannidou, Jan de Dreu

January 2006

ISSN 0924-7815

The Impact of Explicit Deposit Insurance on Market Discipline

Vasso P. Ioannidou*
Tilburg University

Department of Finance & CentER
P.O. Box 90153
5000 LE Tilburg
The Netherlands
Telephone: +31-13-466-3097
Fax: +31-13-466-2875
Email: V.P.Ioannidou@uvt.nl

Jan de Dreu
Tilburg University

Department of Finance & CentER
P.O. Box 90153
5000 LE Tilburg
The Netherlands
Telephone: +31-13-466-3025
Fax: +31-13-466-2875
Email: J.deDreu@uvt.nl

January 18, 2006

* Corresponding author. We would like to thank the Bank Supervisory Authority in Bolivia, and in particular Enrique Hurtado, Guillermo Romano, and Sergio Selaya, for providing the means and support to construct our dataset. For valuable suggestions and comments we would like to thank Hans Degryse, Sonia Falconieri, Harry Huizinga, Steven Ongena, Joe Peek, Fabiana Penas, Maurizio Zanardi as well as seminar participants at the 2005 Bank Structure Conference, the University of Bologna, the K.U. of Leuven, and the Ente Luigi Einaudi. Any remaining errors are our own.

The Impact of Explicit Deposit Insurance on Market Discipline

Abstract

This paper studies the impact of explicit deposit insurance on market discipline in a framework that resembles a natural experiment. We improve upon previous studies by exploiting a unique combination of country-specific circumstances, design features, and data availability that allows us to distinguish between demand and supply effects. We show that deposit insurance causes a significant reduction in market discipline. We also show that the effect of deposit insurance depends on the coverage rate. When the coverage rate is more than 60 percent, market discipline is significantly reduced and it is completely eliminated when the coverage rate reaches 100 percent. Our results also suggest that most market discipline comes from large depositors and that the introduction of deposit insurance affected mainly those who were already active in imposing discipline. Our findings emphasize the need for binding coverage limits per depositor, high degrees of co-insurance, and “tailor made” deposit insurance systems that preserve the incentives of a critical mass of depositors that are willing and able to perform this function.

Keywords: Market Discipline; Deposit Insurance; Deposit Insurance Coverage

JEL Classification Codes: F30, F41, G14, G21, G28

The provision and design of deposit insurance systems presents governments with an unprecedented set of challenges. Deposit insurance systems are typically motivated by a desire to decrease the risk of systemic bank runs (e.g., Diamond and Dybvig (1983)) and to protect small, uninformed depositors (e.g., Dewatripont and Tirole (1994)). Often, however, they are blamed for increasing the incentives of banks to take excessive risk because such systems weaken, or remove entirely, the link between a bank's risk of default and its funding costs (e.g., Kane (1989) and Calomiris (1999)).

Policymakers face a major challenge: how to design a deposit insurance scheme that protects the financial system from systemic bank runs without unduly reducing market discipline. A major concern is that deposit insurance reduces the incentives of depositors to monitor and discipline their banks, through requiring higher interest rates and/or withdrawing their deposits when bank risk increases, with “overly generous” deposit insurance systems or open-ended implicit guarantees having the potential to completely eliminate market discipline. Coupled with weak regulatory and supervisory systems, this could lead to huge costs, both for taxpayers and for the economy more generally, from exacerbating and prolonging crises. The U.S. Savings and Loan (S&Ls) debacle in the mid-1980s is a classic example of such situations (e.g., Kane (1989)).

While most studies of market discipline provide evidence consistent with the hypothesis that market discipline is at work, to date, there is little *direct* evidence on the effect of explicit or implicit deposit insurance on market discipline.¹ The evidence on how

¹ Most of the empirical literature on market discipline uses U.S. data and examines the existence of market discipline in three markets: large certificates of deposit (e.g., Baer and Brewer (1986), Hannan and Hanweck, (1988), and Ellis and Flannery (1992)), subordinate notes and debentures (e.g., Flannery and Sorescu (1996)), and the overnight inter-bank market (e.g., Furfine (2001)). On the interaction between market discipline and deposit insurance see Kane (1987), Cook and Spellman (1991) and (1994), Park and Peristiani (1998), Martinez Peria and Schmukler (2001), and Demirgüç-Kunt and Huizinga (2003).

various design features of a deposit insurance system might affect market discipline is particularly sparse.² To a large extent, this is due to data limitations that force researches to rely on indirect tests and imprecise measures of a bank's marginal cost of funds.

For example, a comparison of the behavior of small with large depositors is used to draw conclusions about the effect of deposit insurance on market discipline, given that most deposit insurance systems provide full coverage up to a certain amount per depositor or account (e.g., Martinez Peria and Schmuckler (2001)). However, small and large depositors differ across many dimensions for which controls are not included (e.g., degree of sophistication, absolute or relative risk-aversion). Others, instead, try to infer the effect of deposit insurance on market discipline using cross-country comparisons (e.g., Demirgüç-Kunt and Huizinga (2003)). The analysis, however, uses a rather heterogeneous set of developed and developing countries, whose financial systems are at very different stages of liberalization and sophistication. A second data limitation, for both studies, concerns the calculation of a measure of a bank's current cost of funds (i.e., the current cost of existing deposits or the cost of new deposits). For most countries, the only available information is an implicit interest rate, calculated as the ratio of interest expenses to total deposits that reflects an average, rather than marginal, measure that averages over various types of deposits and contractual interest rates that reflect market conditions at different points in time.

This study attempts to overcome the weaknesses in the existing literature by exploiting a unique, detailed Bolivian dataset that covers the 1998 to 2003 period. However, the value of this dataset comes not only from the detailed measures available, but also from the country-specific circumstances during this period and the characteristics of the Bolivian

² See Demirgüç-Kunt and Huizinga (2003).

deposit insurance system that provide a “natural experiment” setting for the analysis. In particular, the sample period is characterized by a severe recession that weakened significantly the health of the banking sector, providing depositors with reasons to worry about the safety of their deposits. More importantly, the deposit insurance system was introduced part way through our sample in December 2001, with no other major regulatory reforms during the sample period. This makes it possible to construct consistent time-series and to compare the behavior of depositors before and after the new system was introduced.

Moreover, the Bolivian deposit insurance system presents a unique opportunity to investigate the effect of the coverage rate on market discipline without having to compare the behavior of small and large depositors. With full coverage up to a certain amount per depositor (or per account), typical of most deposit insurance systems, depositors (or accounts) above this limit are only partially insured, and the degree of coverage decreases as the value of deposits increases above this limit.³ The Bolivian system differs by having a coverage limit per bank, which effectively translates into a flat coverage rate per depositor (or per account). This makes it easier to examine the relationship between the coverage rate and market discipline, including the ability to investigate whether small and large depositors are indeed different for reasons other than their degree of deposit insurance coverage.

The Bolivian data provide further benefits from providing more detail than is typical. In particular, the interest rate on deposits is constructed by the Central Bank as a weighted average of the interest rate on all deposits outstanding at the end of each month and is constructed separately by type of deposits (i.e., savings and time deposits) and by currency

³ For example, the United States has a coverage limit of \$100,000 per account. This implies that any account with \$100,000, or less, enjoys a 100 percent coverage rate, while any account above this limit is only partially insured (e.g., accounts with \$300,000 have only a 33.3 percent coverage rate).

denomination. To better capture a bank's marginal costs of funds we focus on savings deposits. Contrary to time deposits, the interest rate on savings deposits can adjust at any point in time, depending on the current economic conditions, and does not depend on the time of initiation. Hence, this measure represents a substantial improvement over what is typically used. Finally, focusing on savings deposits is important not only for the price dimension of our test, but also with respect to the quantity dimension, since banks can refuse the withdrawal of time deposits till maturity. As emphasized by Park (1995)—and explained later in the methodology section— finding evidence on both prices and quantities is crucial in order to distinguish market discipline from alternative hypotheses that are demand, as opposed to supply, driven (e.g., regulatory discipline, gambling for resurrection, etc.).

Our results are consistent with the hypothesis that market discipline is at work. We find that an increase in bank risk leads to higher interest rates on deposits and lower deposit volumes (i.e., we find evidence both on price and quantities). More importantly, we find that the introduction of explicit deposit insurance caused a significant reduction in market discipline. The coefficients of the indicators that capture market discipline are 50 to 90 percent smaller after the introduction of deposit insurance. We also find that the effect of deposit insurance depends on the coverage rate: the higher the coverage rate, the larger the decrease in market discipline. As the coverage rate increases above 60 percent, many of our coefficients start to become insignificant and none of them remains significant when the coverage rate reaches 100 percent. To the best of our knowledge, this paper is the first to provide such direct evidence on the effect of deposit insurance on market discipline.

Given that we have some information by size we also try to infer whether small and large depositors behave differently. Our results are consistent with the hypothesis that most

market discipline comes from large depositors and that the introduction of explicit deposit insurance affected mainly those who were active in the first place. As shown in the sensitivity analysis, this is true even if we take into account a “pollution bias”, resulting from the possible migration of accounts across size categories— a problem that has been completely overlooked by the existing literature on market discipline. All in all, our findings emphasize the need for much higher degrees of co-insurance than those employed by most deposit insurance systems around the world and they are in line with recent proposals to reform the U.S. deposit insurance system by requiring banks to maintain a minimal proportion of subordinate debt finance (e.g., Calomiris (1999)).⁴

This paper contributes to a small but growing literature that investigates empirically the effects of deposit insurance on market discipline. In particular, drawing from the U.S. S&Ls crisis, the evidence shows that even fully insured depositors would discipline their banks if the deposit insurer faces serious financial difficulties (e.g., Cook and Spellman, (1991) and (1994), Kane (1987), and Park and Peristiani (1998)).⁵ More recently, Martinez Peria and Schmukler (2001) find that depositors in Argentina, Chile, and Mexico punish risky banks by withdrawing their deposits and requiring higher interest rates, but do not find any statistically significant effect of deposit insurance on their behavior. They argue that their findings highlight the lack of credibility of deposit insurance in developing countries. Our results, instead, do not support this interpretation. In fact, our results are much closer to the findings of Demirgüç-Kunt and Huizinga (2003). Using data from more than 30

⁴ According to Demirgüç-Kunt et al. (2005) only 26 percent of deposit insurance systems around the world have co-insurance, with the average co-insurance percentage being only 16 percent.

⁵ When the deposit insurer faces serious financial difficulties, there are reasons to believe that deposit insurance could be repudiated (in whole or in part) or that insured depositors could incur indirect costs if their bank fails (e.g., wait for a long time to collect their funds). Hence, in this case, even fully insured depositors might find it optimal to withdraw their funds from risky banks or to require higher risk premiums.

developed and developing countries, Demirgüç-Kunt and Huizinga find that bank interest expenses are lower and less sensitive to indicators of bank risk in countries with an explicit deposit insurance system. They also find that these effects are more pronounced for countries with more generous deposit insurance systems (e.g., systems without co-insurance, high coverage limits, etc.). Although these results are consistent with the hypothesis that market discipline is lower in countries with an explicit deposit system in place, they are only based on estimates from the price equation, and thus do not eliminate alternative hypotheses.

The remainder of the paper is organized as follows. Section I describes the deposit insurance system in Bolivia and contrasts it to the deposit insurance systems in the rest of the world, emphasizing the features that allow us to better address some of the weaknesses of the existing literature. Section II discusses our methodology. Section III describes the data and variables used in the empirical analysis. Section IV presents and evaluates the paper's main results. Section V provides sensitivity analysis, and Section VI concludes.

I. Background

Bolivia introduced an explicit deposit insurance system on December 20, 2001, with the passage of Law 2297. Before that, there were some implicit guarantees.⁶ Hence, our comparison is between explicit, as opposed to implicit, deposit insurance.

With the passage of Law 2297, the “Fund for Financial Restructuring” (thereafter the Fund) was created in order to protect the “preferred obligations” of failing financial institutions. All financial institutions operating in Bolivia are required to contribute to the

⁶ For example, when two commercial banks failed in 1994, the Bolivian Central Bank covered 100 percent of their deposits to the private sector. When another failed in 1997, the Central Bank put a coverage limit up to \$200,000 per account, which essentially covered more than 98 percent of their private sector deposits.

Fund. The insurance premiums are proportional to the institution's private sector deposits. When fully capitalized, the Fund will be 5 percent of the total deposits in the system. Until then, the Bolivian Central Bank is the responsible party. However, even after full capitalization is reached, if the resources of the Fund are insufficient, the Bolivian Central Bank is required by law to supply the lacking resources by debiting against future contributions of the financial intermediaries to the Fund.⁷ Clearly, this back-up support by the Central Bank aims at strengthening the credibility of the newly established system.

The deposit insurance coverage is limited. Before 2005, the Fund covered only up to 50 percent of a bank's "total preferred obligations" (TPOs), while after 2005 it covers only up to 30 percent. The TPOs are divided into first and second order obligations, where second order obligations are subordinate to first order obligations. The first order obligations include obligations to the private sector, which consist primarily of deposits to the private sector. Given that the Bolivian economy is highly dollarized, the Law makes no distinction between foreign denominated deposits and deposits in Bolivianos.⁸ The second order obligations include obligations to the public sector, the Central Bank, and foreign financial entities. Finally, the Law states specifically that interbank deposits are not insured.

The first part of Table I provides some information regarding the *effective coverage* of the deposit insurance system. There are two distinct patterns: i) both before and after deposit insurance, first order obligations are almost always more than 50 percent of TPOs, and ii) the ratio of first order obligations to TPOs increased after the introduction of deposit insurance. The first pattern implies that first order obligations are only *partially* insured,

⁷ See third paragraph of Article 127, Law 2297.

⁸ More than 90 percent of deposits and credits are in U.S. dollars. This high degree of dollarization is one of the longer lasting effects of the hyperinflation of the 1980s. Because the economy is highly dollarized, the exchange rate policy follows a crawling peg with the U.S. dollar. During the sample period, the exchange rate has been depreciating at a roughly constant rate of 6.5 percent per annum, with a peak of 9.7 percent in 2002.

while all second-order obligations are effectively *uninsured* after 2001. Given that first order obligations are on average 84.4 percent of TPOs, on average only 60 percent of first order obligations are insured.⁹ Since there is no priority within the group of first order obligations, this implies that on average only 60 percent of private sector deposits is effectively insured. This percentage varies across banks and time, depending on their ratio of first order obligations to TPOs, but it does not vary between accounts of different size within a given bank. Hence, in the event of bankruptcy, small and large depositors within a given bank will receive the same percentage of their deposits. The second pattern suggests that after the introduction of deposit insurance, first order obligations became more attractive than second order obligations. This increase could be due to a supply effect (i.e., a decrease in market discipline after the introduction of deposit insurance), a demand effect (i.e., an increase in the demand for insured, as opposed to uninsured, funds), or both.¹⁰

Insert Table I here

The second part of Table I compares the deposit insurance system in Bolivia with the deposit insurance systems in the rest of the world. For the most part, the Bolivian system is in line with the rest of the world. The only difference is the absence of full insurance up to a certain amount per depositor (or per account). In particular, 90 percent of the systems in the rest of the world provide full insurance up to a certain amount per depositor (or per account). Depositors that are above this limit are only partially covered and the degree of coverage

⁹ The deposit insurance coverage rate is equal to $50 \times (\text{TPOs} / \text{First Order Obligations})$ if first order obligations is more than 50 percent of TPOs and is equal to 100 percent otherwise.

¹⁰ Billet, Garfinkel, and O'Neal (1998) argue that if the costs of regulatory discipline are lower than the costs of market discipline, banks should replace uninsured funds with insured funds. Using U.S. data, the authors show that banks that have been downgraded by Moody's, experience smaller declines in equity value and increase their absolute and relative reliance on insured deposits, indicating that bank managers perceive the cost of insured deposits to have increased less than the cost of uninsured deposits. Similarly, Gropp and Vesala (2004), using European Union data, find that the introduction of explicit deposit insurance is followed by an increase in the share of insured deposits in banks' liabilities to avoid market discipline.

decreases as the value of the deposits increases above this limit. The Bolivian scheme, instead, has a coverage limit per bank, which effectively translates in a flat and partial coverage rate per depositor (or per account). Hence, compared to the rest of the world, the Bolivian scheme is more generous to large depositors than it is to small depositors.

This rather unusual feature of the Bolivian system was the result of pressure from financial institutions against the first draft of the deposit insurance law that included a coverage limit of \$10,000 per account. This first draft was submitted to the Congress in 1999, but failed to pass given the strong opposition from the country's "business elite".¹¹

II. Methodology

To examine whether depositors respond to increases in bank risk by reducing their supply of deposits, ideally one should estimate a simultaneous equations model specifying demand and supply equations. In practice, however, this is very difficult, since it is hard to find exogenous variables that strongly affect either the supply or the demand equation. Hence, the empirical literature has tried to infer whether market discipline is present using reduced-form equations for the equilibrium interest rates and/or deposits. In particular, market discipline implies that an increase in bank-risk leads to a decrease in the supply of deposits. Thus, everything else equal, it leads to higher interest rates and lower deposits.¹²

¹¹ A number of recent papers have been emphasizing the role of private interest groups on the design of deposit insurance systems around the world. Kroszner and Strahan (2001) find that the voting behavior in the U.S. House of Representatives on the limitation of deposit insurance to a single account per bank is consistent with private interest theories of regulation. More recently, Laeven (2004) finds that cross-country differences in deposit insurance coverage can also be explained by private interest theories.

¹² Whether an increase in bank risk leads to a change in interest rates *and* deposits depends on the elasticities of the two curves (e.g., if the demand curve is perfectly inelastic we should expect only a change in interest rates, while if it is perfectly elastic, we should expect only a change in deposits). However, it is more likely that the demand curve is downward sloping and the supply curve is upward sloping. In general, a bank's demand for deposits is determined by its loan supply. If a bank has finite lending opportunities, due to geographic and regulatory restrictions or limited expertise with certain types of loans, its marginal revenue curve for loans is

Using reduced-form equations, however, is more complicated than it may seem at first sight, since the demand function could also depend on bank risk. For example, an increase in bank risk could be associated with an increase in the demand for deposits, if risky banks are expanding more aggressively. At the same time, an increase in bank risk could be associated with a decrease in the demand for deposits, if banks respond to regulatory discipline by shrinking their operations. For example, banks may respond to regulatory pressures on their capital ratios by reducing their assets and, consequently, their liabilities. Thus, risky banks may lower their interest rates to reduce their deposits.

Since both the demand and the supply functions could depend on bank risk, it is possible that market discipline occurs, but is not strong enough (compared to the demand effect) to be reflected in the equilibrium interest rates and deposits. Figure 1 illustrates this argument graphically. Assuming that the supply curve is upward sloping and the demand curve is downward sloping, an increase in bank risk could lead to four possible cases. In general, the presence of market discipline is most convincing in the first case, most doubtful in the second case, and inconclusive in the third and fourth case (Park (1995)).

Insert Figure 1 here

Figure 1 also highlights that a positive relationship between interest rates and bank risk *and* a negative relationship between deposits and bank risk is a sufficient, but not a necessary, condition for market discipline. We argue, however, that finding both effects would provide the most convincing evidence. Hence, to examine whether there is any market discipline in our sample we estimate the following reduced-form equations:

downward sloping, which implies that its demand for deposits will be downward sloping (Klein (1971)). Similarly, an upward sloping supply curve is consistent with a limit on the amount of deposits per depositor and a finite number of potential depositors or, alternatively, with higher search costs for deposits outside the bank's local market (Flannery (1982)).

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \varepsilon_{i,t} \quad (1)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \eta_{i,t} \quad (2)$$

where $i = 1, \dots, N$ and $t = 1, \dots, T$, and N is the number of banks and T is the number of observations per bank. The panel is unbalanced, which implies that T varies across banks. $InterestRate_{i,t}$ is the interest rate on deposits in bank i at time t , while $\Delta Deposits_{i,t}$ is the growth rate of deposits in bank i at time t .¹³ $BankRisk_{i,t-k}$ is a vector of publicly observable bank risk characteristics and $Controls_{i,t-k}$ is a vector of control variables. These vectors are included with a lag since it takes some time before changes in the independent variables lead to changes in the dependent variables and because the credit-risk indicators are publicly available with a lag, ranging from 20 to 30 days. The specific variables used in these vectors are discussed extensively in the next section.

A positive estimate for β_1 and a negative estimate for β_2 would indicate the existence of market discipline. However, in terms of their economic interpretation, $\hat{\beta}_1$ and $\hat{\beta}_2$ should be viewed as either a *lower* or an *upper bound* of the degree to which depositors penalize their banks. In particular, when one of the two estimates is an upper bound the other will be a lower bound. If the demand for deposits depends positively on bank risk, $\hat{\beta}_1$ would overestimate the degree of market discipline, while $\hat{\beta}_2$ would underestimate it. The opposite

¹³ Following the literature, the growth rate of deposits is used instead of the level because the latter depends more on bank characteristics (e.g., bank size and business orientation) than on supply and demand conditions in a given month. However, using growth rates instead of levels makes it a lot more difficult to find statistically significant coefficients for the bank risk indicators. Even if bank risk affects the level of deposits, it may not affect its growth rate. Moreover, the growth rate series has a lot more noise than the level series. To reduce this problem we use quarterly average growth rates instead of monthly growth rates. Hence, to ensure that our independent variables are predetermined, in the quantity equation we use $k = 3$ (i.e., the independent variables are determined one period before the last period used to calculate the dependent variable).

is true if the demand for deposits depends negatively on bank risk.

To examine whether the introduction of an explicit deposit insurance system affects market discipline, we estimate the following model:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \delta_1 DI_{t-k} + \theta_1 BankRisk_{i,t-k} DI_{t-k} + \varepsilon_{i,t} \quad (3)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \delta_2 DI_{t-k} + \theta_2 BankRisk_{i,t-k} DI_{t-k} + \eta_{i,t} \quad (4)$$

where DI_{t-k} is a dummy variable that equals one when there is explicit deposit insurance, and equals zero otherwise. A negative estimate for θ_1 and a positive estimate for θ_2 would indicate that the introduction of explicit deposit insurance reduces market discipline. In addition, a positive estimate for $\beta_1 + \theta_1$ and a negative estimate for $\beta_2 + \theta_2$ would indicate that deposit insurance reduces, but does not eliminate, market discipline.

Given that the deposit insurance coverage varies across banks depending on their ratio of first order obligations to TPOs, we also examine whether the effect of deposit insurance on market discipline depends on the coverage rate by estimating:

$$InterestRate_{i,t} = \alpha_1 + \beta_1 BankRisk_{i,t-k} + \gamma_1 Controls_{i,t-k} + \delta_1 C_{i,t-k} + \lambda_1 BankRisk_{i,t-k} C_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

$$\Delta Deposits_{i,t} = \alpha_2 + \beta_2 BankRisk_{i,t-k} + \gamma_2 Controls_{i,t-k} + \delta_2 C_{i,t-k} + \lambda_2 BankRisk_{i,t-k} C_{i,t-k} + \eta_{i,t} \quad (6)$$

where $C_{i,t-k}$ is equal to the deposit insurance coverage, calculated as follows:

$$C_{i,t-k} = \begin{cases} 0 & \text{if } DI_{t-k} = 0 \\ 0.5 * X_{t-k} & \text{if } DI_{t-k} = 1 \text{ and } X_{t-k} < 0.5 \\ 1 & \text{if } DI_{t-k} = 1 \text{ and } X_{t-k} \geq 0.5 \end{cases} \quad (7)$$

where X_{t-k} is equal to the ratio of total preferred obligations to first order obligations.

A positive estimate for β_1 and a negative estimate for β_2 would indicate the existence of market discipline before the introduction of deposit insurance (i.e., when $C_{i,t-k} = 0$). Instead, a negative estimate for λ_1 and a positive estimate for λ_2 would indicate that the reduction of market discipline from deposit insurance depends positively on $C_{i,t-k}$. Finally, the combined coefficients $\hat{\beta}_1 + \hat{\lambda}_1 C_{i,t-k}$ and $\hat{\beta}_2 + \hat{\lambda}_2 C_{i,t-k}$ are used to estimate the degree of market discipline for different values of $C_{i,t-k}$.

III. Data and Variables

The paper makes use of a detailed and reliable dataset on the Bolivian banking sector from 1998:1 to 2003:12. The data and all information that were necessary to create consistent time series (e.g., definitions of variables, changes in laws and regulations, etc.) were provided by the Bolivian Superintendence of Banks and Financial Entities (SBEF).

To ensure comparability of the financial institutions in our sample, we focus our analysis on commercial banks. This does not involve any significant loss, since commercial banks capture a dominant part of the market (e.g., 86 percent of total loans). Table II provides an overview of all banks that were active in Bolivia during the sample period. At the beginning, there are sixteen banks, while at end there are twelve banks. During the sample period, one bank failed, another bank was taken over, a foreign bank left the Bolivian market, and one bank was sold after intervention by the SBEF. The five largest banks have a market share of 70 percent of total assets, and two of these banks are foreign. During the sample period, there are no government-owned or de novo banks.¹⁴ As of December 2003,

¹⁴ The last government-owned bank, Banco del Estado, was liquidated in 1994.

six out of twelve banks are foreign, accounting for 33 percent of the market.¹⁵ Since 1993, foreign banks have the same rights as domestic banks (i.e., they are subject to the same regulation), and as of December 2001, both foreign and domestic banks are covered by the deposit insurance system in Bolivia. Moreover, as mentioned in Table II, none of the foreign banks in our sample is subject to explicit deposit insurance from its home country.¹⁶

Insert Table II here

To estimate the model, we use *savings deposits denominated in U.S. dollars*. Focusing on U.S. dollar denominated deposits is not restrictive, since they represent more than 90 percent of total deposits. Focusing on savings deposits, instead of time deposits, allows us to better capture a bank's marginal cost of funds. In particular, time deposits are grouped into various "maturity buckets" (e.g., 90 days, 180 days, etc). Within each bucket, there are deposits issued at different points in time, with the interest rate being determined when the deposits are issued. Hence, like the implicit interest rate, the interest rate on time deposits is only a rough measure of current economic conditions. On the contrary, the interest rate on savings deposits can adjust at any point in time, depending on the current economic conditions, and does not depend on the time of initiation. Finally, focusing on savings deposits, instead of time deposits, has advantages also with respect to the quantity equation, given that banks can refuse the withdrawal of time deposits until maturity.

The independent variables can be grouped into two categories: indicators of bank risk and control variables. For bank risk we use a number of accounting ratios that are publicly available and have been previously used to capture a bank's financial condition (e.g., equity

¹⁵ A bank is defined as foreign if more than 50 percent of its shares are owned by foreigners. However, we consider Banco BISA as an exception to this rule, since a Bolivian investor has majority ownership in the foreign companies that own this bank.

¹⁶ This information was obtained from direct contact with the supervisory authority in each country.

to total assets, nonperforming loans to total assets, loan loss reserves to total assets, overhead expenses to total assets, returns to total assets, and liquid assets to total assets). We also include two additional indicators that may or may not capture bank risk: bank size (measured as the log of total assets) and a foreign bank dummy variable.¹⁷

To control for general macroeconomic conditions we include the growth rate of real GDP in Bolivia and the U.S. inflation rate to deflate the interest rate on U.S. dollar denominated deposits.¹⁸ Finally, we have constructed a (0,1) dummy variable to capture episodes of political instability during the sample period. We control for two events: i) violent confrontations between the police and the public because of the coca eradication policy introduced after pressure from the United States and international organizations, and ii) the severe uncertainty in the financial markets during the elections of July 2002.¹⁹

IV. Results

A. Do depositors penalize their banks for risk taking?

The first panel of Table III reports estimation results for equations (1) and (2) using a benchmark specification. It includes bank-level indicators of bank risk and a number of control variables, such as bank size, a foreign bank dummy, the growth rate of real GDP in Bolivia, the U.S. inflation rate, and the political instability dummy variable.

¹⁷ Bank size could be capturing a bank's market power and reputation, but it could also be capturing a lower probability of failure due to too-big-to-fail policies, better access to funds, better diversification of risk, etc. The foreign bank dummy variable is used to control for possible fixed-effect differences between domestic and foreign banks. In the sensitivity analysis, this variable is interacted with bank risk indicators to examine whether foreign banks are subject to less market discipline than domestic banks.

¹⁸ Including the inflation rate in the equation, instead of using real interest rates, allows for the estimated coefficient on the inflation rate to be different than one, indicating the degree to which banks compensate depositors for the inflation tax.

¹⁹ Before the elections of July 2002, there was severe uncertainty in the financial markets since Evo Morales—the leader of the coca growers, a congressman, and a candidate for the presidential elections— was gaining popularity. His victory, which did not materialize by a small margin, would have meant a major change in the political and economic system towards socialism.

Insert Table III here

The results provide strong evidence that market discipline is at work. Four out of six indicators of bank risk indicators are statistically significant in both equations and have signs that are consistent with market discipline. Specifically, the leverage capital ratio, measured as equity to total assets, enters with a negative sign in the interest rate equation and a positive sign in the deposits equation, suggesting that depositors are willing to supply more deposits to better-capitalized banks. The ratio of nonperforming loans to total assets, which is used to capture credit risk problems, has a positive sign in the interest rate equation and a negative sign in the deposits equation, indicating a decrease in the supply of deposits. The ratio of loan loss reserves to total assets, which captures the degree to which an institution is reserving against credit risk, enters with the opposite signs of nonperforming loans. This implies that everything else equal, including credit risk, depositors are willing to supply more funds to institutions with higher reserves. Similarly, the ratio of overhead expenses to total assets, which is often used to capture bank or managerial inefficiency, suggests that depositors are less willing to supply funds to inefficient banks.²⁰ The return to total assets ratio enters with signs that are consistent with a positive supply effect, but is statistically insignificant in both equations. The only variable that does not show any signs of market discipline is the ratio of liquid assets to total assets; it enters with negative signs in both equations, suggesting that banks with high liquidity demand less deposits.

Most control variables enter with the expected signs. In particular, the log of total assets has a negative sign in both equations, indicating that bigger banks demand less

²⁰ This ratio could also be capturing differences in business orientation or the level of extra services they may offer. For example, banks with high overhead ratios could be offering more personal attention to their customers. Hence, everything else equal, depositors would be willing to supply more deposits to these banks. Our results, however, do not support this alternative hypothesis.

deposits, either because they have access to other sources of funds or because they are expanding less than smaller banks. The foreign bank dummy variable enters with a negative sign in both equations indicating that, everything else equal, foreign banks demand less deposits than domestic banks. The U.S. inflation rate and the growth rate of real GDP in Bolivia have positive and statistically significant coefficients in the interest rate equation, but they are highly insignificant in the quantity equation (i.e., their p-values are around 0.9). Since the coefficients of these variables are so imprecisely estimated, it is hard to say whether they are capturing supply or demand effects based on their signs.

Finally, the dummy variable for political instability is statistically significant in both equations and has a positive sign in the interest rate equation and a negative sign in the deposits equation. This result implies that political instability makes depositors worry about the safety of their deposits and thus, everything else equal, they reduce their supply of deposits, regardless of the health of an individual institution.²¹ These findings are in line with a recent paper by Levy-Yeyati, Martinez Peria, and Schmukler (2004) that emphasizes the importance of systemic risk factors for developing countries.

In the second panel of Table III, we re-estimate equations (1) and (2) using quarterly time dummies instead of the macroeconomic control variables. Our main results with respect to market discipline are the same. In particular, the four indicators that were previously found to capture market discipline (i.e., leverage ratio, nonperforming loans to total assets, loan loss reserves, and overhead expenses) enter again with signs that are consistent with market discipline and they are statistically significant in both equations. Moreover, their

²¹ Since the role of political instability is not a central point to our analysis, we only present results using one dummy variable for all episodes. However, we also experimented with separate dummies for each event. While our main results with respect to bank risk do not change, this exercise highlighted that the most important event of political instability was the uncertainty before and during the elections of 2002.

estimated coefficients are very similar to those reported in the first panel of Table III.

Finally, to evaluate the economic significance of our results, in the third panel of Table III, we report the marginal effects of a one-standard deviation increase in each explanatory variable, using the benchmark specification from the first panel. The marginal effect of a dummy variable is calculated as the discrete change in the dependent variable as the dummy variable increases from zero to one. With respect to the interest rate equation, the marginal effects of the four key indicators vary between 30 to 90 basis points. In the deposits equation, the marginal effects of these variables are between 5.3 and 11.5 percent. Although, the marginal effects in the interest rate equation may seem small at first glance, they are actually quite large if we take into account that the average interest rate during the sample period is 3.7 percent, with a standard deviation equal to 2.1 percent.

B. Did the introduction of deposit insurance affect the behavior of depositors?

To examine whether the introduction of explicit deposit insurance affected the extent to which depositors penalize their banks, we estimate equations (3) and (4) using the benchmark specification that was presented in the first panel of Table III.

The results, presented in the first panel of Table IV, indicate that the introduction of explicit deposit insurance caused a significant reduction in market discipline. The four indicators that were previously found to capture market discipline enter again with signs that are consistent with market discipline (i.e., $\hat{\beta}_1 > 0$ and $\hat{\beta}_2 < 0$), while their interaction terms with DI_{t-k} enter with the opposite signs (i.e., $\hat{\theta}_1 < 0$ and $\hat{\theta}_2 > 0$), causing sizable reductions to the original coefficients. The combined coefficients, $\hat{\beta}_1 + \hat{\theta}_1$ and $\hat{\beta}_2 + \hat{\theta}_2$, are 50 to 90 percent smaller than the original coefficients. Nevertheless, some of the combined

coefficients are statistically significant, suggesting that the introduction of deposit insurance did not completely eliminate market discipline. In particular, the leverage ratio and the ratio of nonperforming loans to total assets are statistically significant in both equations, while the ratio of overhead expenses to total assets is significant only in the interest rate equation.

Insert Table IV here

To examine whether the effect of deposit insurance depends on the coverage rate, we also estimate equations (5) and (6), exploiting the variation in the coverage rate across banks. The results, presented in the second panel of Table IV, show that the reduction in market discipline depends positively on the coverage rate (i.e., the higher the coverage rate, the larger the reduction in market discipline). In Figure 2 we report the values and the statistical significance of the combined coefficients, $\hat{\beta}_1 + \hat{\lambda}_1 C_{i,t-k}$ and $\hat{\beta}_2 + \hat{\lambda}_2 C_{i,t-k}$, for different values of $C_{i,t-k}$. Figure 2 shows clearly that as the coverage rate increases above 60 percent, many of the coefficients start to become insignificant. More importantly, when the coverage rate is 100 percent, none of the coefficients remains statistically significant.

Insert Figure 2 here

These results indicate that the reason for which deposit insurance did not completely eliminate market discipline, as suggested by the results in the first panel of Table IV, is due to the partial coverage, as opposed to issues of credibility of the deposit insurance system or indirect costs associated with the recovery of deposits from a failed bank. Perhaps more importantly, these results emphasize the need for much higher degrees of co-insurance than those employed by most deposit insurance system around the world. According to Demirgüç-Kunt et al. (2005) only 26 percent of deposit insurance systems around the world have co-insurance, with the average co-insurance percentage being only 16 percent.

C. Do small depositors behave differently than large depositors?

Deposit insurance systems are often motivated or designed to protect small unsophisticated depositors that are either not able, or find it too expensive, to monitor and discipline their banks. Given that we have some information by size of accounts we try to infer whether small and large depositors behave differently with respect to market discipline. In particular, the data that are used to construct the growth rate of deposits are available by size, which allows us to estimate the quantity equation separately for small and large depositors.²²

Table V reports estimation results for equation (2) using alternative thresholds for small and large depositors. The results suggest that the transition between responding or not to bank risk occurs somewhere between \$1,000 and \$5,000.²³ In particular, depositors with at most \$1,000 are not found to respond to risk. When the threshold is increased to \$5,000, small depositors start to respond in a fashion consistent with market discipline. These effects become even stronger, in terms of size and significance, when the threshold is increased to \$10,000 or above. In Table V we report estimates using a \$10,000 threshold, but larger and more significant coefficients can be obtained using higher thresholds. This upward trend can also be seen from the estimates of large depositors. For example, accounts with at least \$10,000 are more responsive than accounts with at most \$10,000; the differences between the coefficients of small and large depositors are significant at 1 percent.²⁴

²² The value of deposits is broken down in 14 categories: up to \$500, between \$501-\$1,000, between \$1,001-\$5,000, etc. The largest size category includes accounts with more than \$2,000,000.

²³ To put these numbers into perspective, we should point out the annual per capita GDP in Bolivia is \$1,000.

²⁴ To examine whether the differences in the betas are statistically different, we re-estimated equation (2) using interaction terms between the indicators of bank risk and a dummy variable that equals 1 when an account has \$10,000 or less. These results are not reported in the paper but are available upon request.

Insert Table V here

Similarly, equation (4) is estimated separately for small and large depositors to examine whether deposit insurance affected these groups differently. The results, presented in Table VI, indicate that deposit insurance significantly reduced the sensitivity of large depositors to bank risk, but did not affect the behavior of small depositors, unless accounts above \$10,000 are included in the definition of small. In Table VI we report results using the \$10,000 and \$20,000 thresholds for small depositors. The results using the \$15,000 threshold, which are not reported, are somewhere in between those of \$10,000 and \$20,000.

Insert Table VI here

All in all, our results are consistent with the hypothesis that most market discipline comes from large depositors and that the introduction of explicit deposit insurance affected mainly those who were active in the first place. However, this interpretation should be viewed with caution since it only relies on estimates from the quantity equation, as the interest rate series are not available by size. In the sensitivity analysis, we discuss how a possible “pollution bias”, resulting from the migration of accounts across size categories, affects our estimates and the interpretation of our results with respect to size.

V. Sensitivity Analysis

A. Fixed Effects

As a first robustness check we re-estimate equations (1) and (2) using bank fixed effects. Fixed effects estimators highlight the variation of deposits over time, using deviations from each bank’s mean. The estimation results, presented in the first panel of Table VII, are similar to the pooled estimates in Table III. The only notable difference is that two of the

relevant coefficients, the leverage ratio in the interest rate equation and the overhead expenses in the deposits equation, are less significant than their counterparts in Table III.

Insert Table VII here

Similarly, we also re-estimated equations (3) and (4) using bank fixed effects. The results, presented in the second Panel of Table VII, are similar to those presented earlier; they are only slightly weaker in terms of statistical significance.

B. Pollution bias

Our results with respect to small and large depositors are subject to a possible “pollution” bias. If there is market discipline, depositors withdraw their funds when a bank’s financial condition deteriorates. They can withdraw all or part of their funds. The latter case is problematic. If the amount left in the account falls into the small size category, large accounts will record a fall larger than the amount withdrawn, while small accounts will record a smaller drop or even an increase. This implies that our estimates in Table V tend to overestimate market discipline for large depositors and underestimate it for small depositors.

To examine the potential size of this bias, we collected data on the number of accounts. Using the \$10,000 threshold, we find that on average, across banks and time, there are 45,671 small accounts and 880 large accounts. Since the number of large accounts is only 2 percent of the small accounts, one could argue that the bias is likely to be small. However, if all large depositors were to drop into the small accounts, the maximum amount they could transfer would be 42 percent of the small deposits, which is quite large.²⁵ To examine the possible effects of this bias on our results, we reconstruct our series for small

²⁵ The average dollar value of small savings deposits is \$20.90 million (40 percent of savings deposits) and the maximum amount that each large depositor could transfer in the small size category is \$10,000.

and large deposits by removing the maximum possible “pollution” from the original series:

$$Large\ Deposits_Adjusted_{i,t} = Large\ Deposits_Original_{i,t} - \$10,000(N_{i,t-1}^L - N_{i,t}^L) \quad (5)$$

$$Small\ Deposits_Adjusted_{i,t} = Small\ Deposits_Original_{i,t} + \$10,000(N_{i,t-1}^L - N_{i,t}^L) \quad (6)$$

where $N_{i,t}^L$ and $N_{i,t}^S$ are the number of large and small accounts, respectively.

Using the adjusted series, we re-estimate equation (2). The results, presented in the third panel of Table VII, show that both large and small depositors discipline their banks, but small depositors impose less market discipline. As expected, the difference between small and large depositors is smaller using the adjusted series than with the original series (see Table V for comparison). It should be pointed out that these estimates do not measure the actual degree of market discipline, but simply provide a *lower bound* for large depositors and an *upper bound* for small depositors. Given that we still find that small depositors impose less market discipline, we can conclude that regardless of the actual degree of market discipline, small depositors impose less market discipline than large depositors.

C. Foreign vs. Domestic Banks

Although the results, presented in Table IV, are consistent with the hypothesis that the introduction of deposit insurance reduced market discipline, they are also consistent with an alternative hypothesis. In particular, the ratio of foreign banks to domestic banks increased during the sample period. Hence, to the extent that foreign banks are subject to less market discipline, our results could be due to the increase of foreign banks in the sample.²⁶ To

²⁶ A growing literature on foreign bank entry argues that foreign banks in developing countries might be more efficient and less corrupted than domestic banks. Hence, depositors might trust foreign banks more than

examine this possibility, we estimated equations (3) and (4) using a sub-period, from April 1999 till the end of the sample, for which the number of foreign banks in the sample is equal to the number of domestic banks. The results, presented in the first panel of Table VIII, are very similar to those presented earlier in Table IV, which implies that the deposit insurance dummy variable is not picking up the relative increase of foreign banks in the sample.

Insert Table VIII here

Finally, we also examine whether foreign and domestic banks are indeed subject to different degrees of market discipline by interacting the indicators of bank risk in equations (1) and (2) with the foreign bank dummy variable. The estimation results, presented in the second panel of Table VIII, show that foreign banks are indeed subject to less market discipline. We also tried to investigate whether there is a difference between foreign branches and foreign subsidiaries, but found no statistically significant difference.²⁷

VI. Conclusions

This paper examines the effect of explicit deposit insurance on market discipline in a framework that resembles a natural experiment, using the experiences of Bolivia between 1998 and 2003. The sample period is characterized by a severe recession that weakened significantly the health of the banking sector. Hence, depositors have reasons to worry about the safety of their deposits. More importantly, during the sample period, there are no major regulatory reforms apart from the introduction of a deposit insurance system in December 2001. This makes it possible to investigate the effect of explicit deposit insurance on market

domestic banks. Foreign banks may also enjoy implicit deposit insurance from the home country, and thus they may be subject to less market discipline.

²⁷ These results are not presented in the paper, but are available upon request.

discipline by comparing the behavior of depositors before and after the introduction of deposit insurance. Moreover, the characteristics of the Bolivian system allow us to examine whether the effect of deposit insurance depends on the coverage rate, without having to compare the behavior of small and large depositors; a more difficult exercise.

The data and the methodology employed improve upon previous studies in at least two ways. First, the data availability with respect to interest rates and our focus on savings deposits provide us with a much more accurate indicator of a bank's current cost of funds than those employed by previous studies. Second, we provide evidence both on prices and quantities, which is important in order to distinguish market discipline from alternative hypotheses (e.g., regulatory discipline, gambling for resurrection, etc.).

In contrast to other studies on developing countries we find a strong link between bank fundamentals and the supply of deposits, consistent with the hypothesis that market discipline is at work. We find that an increase in bank risk leads to higher interest rates and lower deposits. The results also suggest that most of the market discipline comes from large depositors. Nevertheless, "small" depositors, with at least \$5,000 to \$10,000 in their account, are also found to respond to bank risk. As shown in the sensitivity analysis, these results are not due to a possible "pollution bias" across the two size categories.

More importantly, we find that the introduction of explicit deposit insurance caused a significant reduction in market discipline. After the introduction of deposit insurance, the coefficients of the variables that capture market discipline are 50 to 90 percent smaller than before the introduction of deposit insurance. Moreover, by exploiting the variation in the coverage rate across banks, we find that the effect of deposit insurance on market discipline depends on the coverage rate. The higher the coverage rate, the larger the decrease in market

discipline after the introduction of deposit insurance. We find that as the coverage rate increases above 60 percent, many of our coefficients start to become insignificant and none of them remains significant when the coverage rate reaches 100 percent.

This implies that the deposit insurance system in Bolivia is credible and that indirect costs, associated with the recovery of deposits from a failed bank, are not important enough for depositors to continue monitoring and disciplining their banks. More generally, however, these findings emphasize the need for serious degrees of co-insurance and “tailored made” deposit insurance systems that would preserve the incentives of a critical mass of depositors that are willing and able to monitor their banks. In this case, the deposit insurance system covered a significant part of the deposits of those who were active in the first place and thus caused an almost complete elimination of market discipline. In this sense, our results also emphasize the need for “meaningful” coverage limits per depositor and they are in line with recent proposals to reform the U.S. deposit insurance system by requiring banks to maintain a minimal proportion of subordinate debt finance (e.g., Calomiris (1999)).

Finally, our findings also suggest that the degree of market discipline differs between domestic and foreign banks. Foreign banks are subject to less market discipline than domestic banks. In addition, we find that depositors “run” more from domestic banks than from foreign banks whenever there are episodes of political instability. These results are consistent with the hypothesis that foreign banks are trusted more than domestic banks, either because they are more efficient or because they are perceived to have implicit guarantees from their home country or their parent company.

References

- Baer, Herbert, and Elijah Brewer, 1986, Uninsured deposits as a source of market discipline: Some new evidence, *Economic Perspectives*, Federal Reserve Bank of Chicago, 23-31.
- Billet, Matthew T., Jon A. Garfinkel, and Edward S. O'Neal, 1998, The cost of market versus regulatory discipline in banking, *Journal of Financial Economics* 48, 333-358.
- Calomiris Charles W., Building an incentive-compatible safety net, 1999, *Journal of Banking and Finance* 23 (10): 1499-1519.
- Cook, Douglas O., and Lewis J. Spellman, 1991, Federal financial guarantees and the occasional market pricing of default risk: Evidence from insured deposits, *Journal of Banking & Finance* 15 (6): 1113-1130.
- Cook, Douglas O., and Lewis J. Spellman, 1994, Repudiation risk and restitution costs: toward understanding premiums on insured deposits, *Journal of Money, Credit, and Banking* 26 (3): 439-459.
- Demirgüç-Kunt, Asli, and Harry Huizinga, 2003, Market discipline and deposit insurance, *Journal of Monetary Economics* 51 (2): 375-399.
- Demirgüç-Kunt, Asli, Baybars Karacaovali, and Luc Laeven, 2005, *Deposit insurance around the World: A comprehensive database*, Working Paper 3628, World Bank, Washington DC.
- Dewatripont, Mathias, and Jean Tirole, 1994, *The prudential regulation of banks*, MIT Press, Cambridge, MA.
- Diamond, Douglas W., and Philip H. Dybvig, 1983, Bank runs, deposit insurance, and liquidity, *Journal of Political Economy* 91 (3): 401-419.
- Ellis, David M., and Mark J. Flannery, 1992, Does the debt market assess large banks' risk? Time series evidence from money center CDS, *Journal of Monetary Economics* 30 (3): 481-502.
- Flannery, Mark J., 1982, Retail bank deposits as quasi-fixed factors of production, *American Economic Review* 72 (3): 527-536.
- Flannery, Mark J., and Sorin M. Sorescu, 1996, Evidence of market discipline in subordinated debenture yields: 1983-1991, *Journal of Finance* 51 (4): 1347-1377.
- Furfine, Craig, 2001, Banks as Monitors of Other Banks: Evidence from the overnight

- federal funds market, *Journal of Business* 74 (1): 33-57.
- Garcia, Gillian, 1999, *Deposit Insurance: Actual and Best Practices*, IMF Working Paper 99/54, Washington DC: International Monetary Fund.
- Gropp, Reint, and Jukka Vesala, 2004, Deposit Insurance, Moral Hazard, and Market Monitoring, *European Central Bank working paper*, n. 302.
- Hannan, Timothy H., and Gerald A. Hanweck, 1988, Bank insolvency risk and the market for large certificates of deposit, *Journal of Money, Credit, and Banking* 20 (2): 203-211.
- Kane, Edward J., 1987, Who should learn what from the failure and delayed bailout of the ODGF?, *Proceedings of a Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, 306-326.
- Kane, Edward J., 1989, *The S&L insurance mess: How did it happen?*, Urban Institute Press, Washington DC.
- Klein, Michael A., 1971, A theory of the banking firm, *Journal of Money, Credit, and Banking* 3 (2): 205-218.
- Kroszner, Randall S. and Philip E. Strahan, 2001, Obstacles to optimal policy: The interplay of politics and economics in shaping bank supervision and regulation reforms, In: Frederic S. Mishkin, ed., *Prudential supervision: What works and what doesn't*, Chicago: University of Chicago Press, 233-273.
- Laeven, Luc, 2004, The political economy of deposit insurance, *Journal of Financial Services Research* 26 (3): 201 – 224.
- Levy-Yeyati, Eduardo, Maria S. Martinez Peria, and Sergio L. Schmukler, 2004, Market Discipline in Emerging Economies: Beyond Bank Fundamentals, unpublished transcript.
- Martinez Peria, Maria S., and Sergio L. Schmukler, 2001, Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises, *Journal of Finance* 56 (3): 1029-1051.
- Park, Sangkyun, 1995, Market discipline by depositors: evidence from reduced form equations, *Quarterly Review of Economics and Finance* 35 (3) 497-514.
- Park, Sangkyun, and Stavros Peristiani, 1998, Market discipline by thrift depositors, *Journal of Money, Credit, and Banking* 30 (3): 347-364.

Table I
The Bolivian deposit insurance system in perspective

Panel 1 contains information about the effective coverage of the deposit insurance system. Panel 2 compares the Bolivian deposit insurance system to systems in the rest of the world. All numbers in this table are in percentages.

Panel 1: Effective coverage in Bolivia	Before	After	Difference	
First order obligations to total preferred obligations	79.2	84.4	5.2 ^a	
Observations for which first order obligations are fully insured		1.9		
Deposit insurance coverage rate ^b				
Mean		60.0		
Standard deviation		10.3		
Min		50.6		
Max		100.0		
Panel 2: Characteristics of deposit insurance systems around the world ^c	Bolivia	All Countries	High & Upper Middle Income	Lower Middle & Low Income
Participation is compulsory	√	91.5	95.7	86.1
There is a permanent fund	√	83.1	73.9	94.6
Insurance premiums are risk-adjusted	×	24.4	19.6	30.6
Interbank deposits are covered	×	17.3	6.7	30.6
Foreign currency deposits are covered	√	76.5	75.6	77.8
Full insurance up to a certain amount per account/depositor	×	90.9	97.9	82.9
Percentage of deposit value (fully or partially) insured	60	52.4	54.8	49.7
Percentage of deposit accounts (fully or partially) insured	100	92.0	92.3	91.9

^a The difference in the ratio of first order obligations before and after the introduction of deposit insurance is statistically significant at 1 percent.

^b The deposit insurance coverage rate is equal to $50 \times (\text{Total Preferred Obligations} / \text{First Order Obligations})$ if first order obligations are more than 50 percent of total preferred obligations and is equal to 100 percent otherwise.

^c The percentages in Panel B are calculated using data reported in Demirgüç-Kunt et al. (2005), with the exception of the last row that uses data from Garcia (1999). "All Countries": reports the percentage of all explicit deposit insurance systems with a certain characteristic. According to Demirgüç-Kunt et al. (2005), as of 2003 there are 88 countries with an explicit deposit insurance system, 47 of which are classified as high and upper-middle income countries. "High & Upper Middle Income": reports the percentage of deposit insurance systems in high and upper middle-income countries that have a certain characteristic. Similarly "Lower Middle & Low Income": reports the percentage of deposit insurance systems in lower middle and low middle-income countries that have a certain characteristic.

Table II
Overview of all banks in our sample

This table provides an overview of all commercial banks operating in Bolivia during the period 1998:1 to 2003:12.

Bank Name	Market Share ^a		Ownership ^b	Country of Parent Bank	Explicit Deposit Insurance From the Home Country
	January, 1998	December, 2003			
Banco Santa Cruz	22.1	11.2	Foreign Subsidiary (17-07-98)	Spain	No
Banco Nacional de Bolivia	12.9	16.2	Domestic		
Banco Industrial ^c	11.2	16.0	Domestic		
Banco Mercantil	11.2	15.1	Domestic		
Banco de la Unión	9.5	8.3	Domestic		
Banco de Crédito de Bolivia	7.7	11.7	Foreign Subsidiary (30-12-92)	Peru	No
Banco Boliviano Americano	5.8		Domestic		
Banco Económico	5.5	6.3	Domestic		
BHN Multibanco	4.3		Domestic		
Banco de La Paz	3.7		Domestic		
Banco Ganadero	2.0	4.9	Domestic		
Banco Solidario ^d	1.5	3.0	Foreign Owned (15-03-99)	Mix ^d	No
Citibank	1.3	5.8	Foreign Branch (10-10-66)	United States	No
Banco de la Nación Argentina	0.8	0.4	Foreign Branch (28-04-58)	Argentina	No
Banco Real / ABN Amro	0.4		Foreign Branch	Brazil/Netherlands	No
Banco do Brasil	0.2	1.2	Foreign Branch (01-07-61)	Brazil	No

^a Market share is calculated in terms of total assets.

^b Foreign subsidiary: a bank operating in Bolivia for which more than 50 percent of its shares is owned by a foreign company; Foreign owned: a bank operating in Bolivia for which more than 50 percent of its shares are owned by foreign companies; Foreign branch: a bank operating in Bolivia that is an integral part of a foreign bank (i.e., it is not a separate legal entity). The dates in parentheses indicate when a bank changed from domestic to foreign or the date a foreign branch started its operations in Bolivia.

^c Banco Industrial is not considered a foreign bank although, more than 50 percent of this bank is owned by foreign companies. It is viewed as a domestic bank because a Bolivian investor has a majority share in some of these foreign companies.

^d Banco Solidario has the legal status of a bank, but it focuses mainly on micro-credit lending. Hence, this bank is more comparable to micro-credit institutions rather than commercial banks. In terms of ownership, 24 percent of the shares of this bank is owned by a Costa Rican company, 22 percent is owned by a British company, and 22 percent is owned by an American company.

Table III
Do depositors discipline their banks?

For the interest rates columns the dependent variable is the interest rate on savings deposits and for the deposits columns the dependent variable is the average growth rate of savings deposits. The standard errors, in parentheses, are corrected for heteroskedasticity.

	Panel 1		Panel 2		Panel 3	
	Interest Rates	Deposits	Interest Rates	Deposits	Interest Rates	Deposits
Leverage capital ratio	-0.04*** (0.01)	1.30** (0.66)	-0.06*** (0.01)	1.12** (0.56)	-0.34*** (0.09)	11.52** (5.85)
Nonperforming loans to total assets	0.05*** (0.01)	-1.78*** (0.40)	0.03*** (0.01)	-1.98*** (0.47)	0.31*** (0.07)	-11.18*** (2.51)
Loan loss reserves to total assets	-0.24*** (0.03)	1.55*** (0.54)	-0.21*** (0.03)	1.96* (1.07)	-0.88*** (0.10)	5.26*** (1.83)
Overhead expenses to total assets	1.77*** (0.31)	-24.84*** (5.96)	1.65*** (0.30)	-27.04*** (8.08)	0.42*** (0.08)	-5.91*** (1.42)
Return to total assets	-0.002 (0.01)	0.17 (0.13)	0.001 (0.01)	0.16 (0.12)	-0.01 (0.05)	1.13 (0.91)
Liquid assets to total assets	-0.02*** (0.01)	-0.49 (0.51)	0.001 (0.01)	-0.41 (0.45)	-0.12*** (0.05)	-2.40 (2.51)
Log of total assets	-0.46*** (0.07)	-6.25*** (2.21)	-0.62*** (0.08)	-7.40*** (2.34)	-0.59*** (0.10)	-7.88*** (2.79)
Foreign Bank Dummy	-0.47*** (0.09)	-1.38 (2.31)	-0.57*** (0.09)	-1.22 (2.98)	-0.47*** (0.09)	-1.38 (2.31)
U.S. inflation rate	0.66*** (0.06)	0.22 (1.19)			0.49*** (0.05)	0.16 (0.89)
Growth rate of real GDP in Bolivia	0.18*** (0.02)	-0.04 (1.01)			0.23*** (0.03)	-0.06 (1.55)
Political instability dummy	0.34** (0.16)	-5.97** (2.82)			0.34** (0.16)	-5.97** (2.82)
Quarterly dummies	Not Included	Not Included	Included	Included	Not Included	Not Included
Observations	842	863	842	863	842	863
R-Square	0.74	0.14	0.74	0.17	0.74	0.14

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table IV

Did the introduction of explicit deposit insurance affect market discipline?

For the interest rates columns the dependent variable is the interest rate on savings deposits and for the deposits columns the dependent variable is the average growth rate of savings deposits. The “DI effect” (“Coverage”) columns show the coefficients of the interaction terms between the deposit insurance dummy variable (deposit insurance coverage rate) and indicators of bank risk. The standard errors, in parentheses, are corrected for heteroskedasticity.

	Panel 1				Panel 2			
	Interest Rates		Deposits		Interest Rates		Deposits	
		DI effect		DI effect		Coverage		Coverage
Leverage capital ratio	-0.07*** (0.01)	0.05*** (0.01)	1.50* (0.84)	-0.74 (0.73)	-0.07*** (0.01)	0.07*** (0.02)	1.47* (0.80)	-1.39 (1.27)
Nonperforming loans to total assets	0.03 (0.02)	-0.06*** (0.02)	-2.69*** (0.76)	1.61*** (0.66)	0.01 (0.02)	-0.02 (0.03)	-2.32*** (0.69)	1.99* (1.08)
Loan loss reserves to total assets	-0.36*** (0.04)	0.33*** (0.05)	4.60** (1.99)	-4.22** (1.84)	-0.30*** (0.04)	0.33*** (0.06)	4.06** (1.71)	-5.57** (2.56)
Overhead expenses to total assets	2.44*** (0.34)	-1.36*** (0.50)	-35.77*** (11.60)	27.96* (15.69)	2.26*** (0.32)	-1.40* (0.79)	-34.35*** (10.54)	38.80* (21.13)
Return to total assets	0.03** (0.01)	-0.04*** (0.01)	0.56 (0.45)	-0.49 (0.46)	0.02 (0.01)	-0.03* (0.02)	0.53 (0.42)	-0.63 (0.51)
Liquid assets to total assets	-0.05*** (0.01)	0.05*** (0.01)	-0.11 (0.51)	-0.17 (0.67)	-0.04*** (0.01)	0.06*** (0.02)	-0.14 (0.51)	0.09 (0.96)
Log of total assets	-0.42*** (0.09)		-6.50*** (2.31)		-0.45*** (0.09)		-6.93*** (2.28)	
Foreign bank dummy	-0.43*** (0.09)		-2.79 (3.55)		-0.45*** (0.09)		-3.78 (3.42)	
U.S. inflation rate	0.28*** (0.05)		-2.39 (2.18)		0.32*** (0.06)		-2.14 (1.88)	
Growth rate of real GDP in Bolivia	-0.01 (0.03)		-1.06 (1.22)		0.03 (0.03)		-1.00 (1.20)	
Political instability dummy	0.45*** (0.15)		-6.79*** (2.69)		0.22 (0.18)		-8.16** (3.67)	
Observations	842		863		842		863	
R-Square	0.81		0.15		0.78		0.15	

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table V
Do small and large depositors behave differently?

This table reports estimates of the quantity equation for various size categories. The standard errors, in parentheses, are corrected for heteroskedasticity.

	Small Depositors			Large Depositors		
	≤ \$1,000	≤ \$5,000	≤ \$10,000	> \$10,000	> \$20,000	> \$30,000
Leverage capital ratio	0.26 (0.21)	0.27*** (0.09)	0.27*** (0.09)	1.29** (0.68)	1.62** (0.83)	1.63** (0.82)
Nonperforming loans to total assets	-0.32 (0.22)	-0.19* (0.10)	-0.15** (0.07)	-2.11*** (0.50)	-2.34*** (0.57)	-2.38*** (0.57)
Loan loss reserves to total assets	-0.25 (0.28)	-0.08 (0.13)	0.03 (0.12)	2.14*** (0.69)	2.36*** (0.80)	2.41*** (0.80)
Overhead expenses to total assets	-7.22*** (2.84)	-1.69 (1.29)	-2.08** (0.99)	-27.14*** (7.07)	-29.55*** (8.24)	-29.25*** (8.29)
Return to total assets	-0.07 (0.09)	-0.05 (0.07)	-0.01 (0.04)	0.23 (0.15)	0.28 (0.18)	0.29 (0.19)
Liquid assets to total assets	-0.27 (0.20)	-0.12 (0.09)	-0.02 (0.08)	-0.68 (0.55)	-0.89 (0.65)	-0.93 (0.64)
Log of total assets	-2.88** (1.47)	-0.09 (0.60)	0.18 (0.43)	-7.39*** (2.40)	-7.88*** (2.65)	-8.00*** (2.64)
Foreign Bank Dummy	1.11 (0.99)	-0.43 (0.44)	-0.78** (0.39)	-1.64 (2.47)	-2.50 (2.95)	-2.36 (2.94)
U.S. inflation rate	-1.79*** (0.63)	-1.04** (0.44)	0.23 (0.31)	-0.56 (1.22)	-0.71 (1.36)	-0.81 (1.38)
Growth rate of real GDP in Bolivia	0.48 (0.47)	0.23 (0.23)	0.18 (0.20)	-1.45 (1.36)	-1.79 (1.60)	-1.83 (1.60)
Political instability dummy	-0.48 (1.50)	0.95 (1.21)	-1.09 (0.76)	-7.63*** (3.09)	-8.90*** (3.58)	-8.42** (3.57)
Observations	834	839	839	844	844	844
R-Square	0.10	0.09	0.10	0.13	0.13	0.13

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table VI

Did the introduction of explicit deposit insurance affect small and large depositors differently?

This table reports estimates of the quantity equation for various size categories. The “DI effect” columns show the coefficients of the interaction terms between the deposit insurance dummy variable and indicators of bank risk. The standard errors, in parentheses, are corrected for heteroskedasticity.

	Small Depositors				Large Depositors			
	≤ \$10,000	DI effect	≤ \$20,000	DI effect	> \$20,000	DI effect	> \$30,000	DI effect
Leverage capital ratio	0.30*** (0.11)	-0.08 (0.11)	0.43*** (0.11)	-0.30*** (0.10)	2.06* (1.12)	-1.20 (0.97)	2.07* (1.11)	-1.15 (0.96)
Nonperforming loans to total assets	-0.25** (0.13)	0.22* (0.12)	-0.36*** (0.14)	0.35*** (0.14)	-3.54*** (1.01)	2.30*** (0.90)	-3.49*** (1.01)	2.18*** (0.90)
Loan loss reserves to total assets	-0.08 (0.29)	-0.28 (0.30)	0.60* (0.33)	-0.76** (0.34)	6.90*** (2.73)	-6.43*** (2.52)	6.80*** (2.70)	-6.35*** (2.50)
Overhead expenses to total assets	-2.41* (1.38)	4.70** (2.03)	-5.39*** (1.80)	10.01*** (2.74)	-45.39*** (15.95)	39.32** (20.76)	-44.64*** (15.77)	40.48** (20.71)
Return to total assets	-0.04 (0.08)	0.04 (0.09)	0.11 (0.10)	-0.13 (0.10)	0.86 (0.59)	-0.79 (0.60)	0.94* (0.57)	-0.89 (0.59)
Liquid assets to total assets	-0.04 (0.10)	0.05 (0.13)	0.10 (0.12)	-0.05 (0.16)	-0.54 (0.67)	0.17 (0.83)	-0.59 (0.67)	0.18 (0.83)
Log of total assets	0.37 (0.46)		0.25 (0.42)		-7.41*** (2.86)		-7.43*** (2.84)	
Foreign bank dummy	-0.45 (0.46)		-1.33*** (0.52)		-4.27 (4.31)		-4.16 (4.26)	
U.S. inflation rate	-0.59* (0.35)		-0.12 (0.37)		-3.61 (2.83)		-3.52 (2.81)	
Growth rate of real GDP in Bolivia	-0.25 (0.20)		-0.07 (0.19)		-1.67 (1.60)		-1.68 (1.60)	
Political instability dummy	-1.39* (0.76)		-1.41* (0.78)		-9.48*** (3.34)		-9.05*** (3.35)	
Observations	839		839		844		844	
R-Square	0.11		0.18		0.14		0.15	

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table VII
Sensitivity analysis

Panel 1 and 2 report estimates using bank fixed-effects. For the interest rates columns the dependent variable is the interest rate on savings deposits and for the deposits columns the dependent variable is the average growth rate of savings deposits. The “DI effect” columns show the coefficients of the interaction terms between the deposit insurance dummy variable and indicators of bank risk. Panel 3 reports estimates of the quantity equation after correcting for a possible pollution bias, resulting from the migration of accounts across size categories. The standard errors, in parentheses, are corrected for heteroskedasticity.

	Panel 1		Panel 2				Panel 3	
	Interest Rates	Deposits	Interest Rates	DI effect	Deposits	DI effect	Small ≤ \$15,000	Large > \$15,000
Leverage capital ratio	-0.02** (0.01)	0.98** (0.49)	-0.12*** (0.01)	0.11*** (0.02)	1.21** (0.54)	-0.41 (0.53)	0.09 (0.11)	1.31** (0.67)
Nonperforming loans to total assets	0.05*** (0.01)	-2.62*** (0.58)	-0.02 (0.02)	-0.03 (0.02)	-4.02*** (1.06)	2.20* (1.15)	-0.51*** (0.16)	-2.09*** (0.50)
Loan loss reserves to total assets	-0.25*** (0.03)	3.10*** (1.14)	-0.27*** (0.03)	0.24*** (0.05)	7.21*** (1.98)	-6.41*** (2.14)	0.38* (0.20)	1.98*** (0.69)
Overhead expenses to total assets	1.79*** (0.21)	-20.02* (12.16)	1.82*** (0.20)	-0.98** (0.45)	-24.77* (13.37)	28.42 (22.11)	-8.09*** (2.49)	-26.41*** (6.97)
Returns to total assets	-0.003 (0.01)	0.26 (0.26)	0.03*** (0.01)	-0.04*** (0.01)	0.96* (0.53)	-0.89 (0.61)	-0.03 (0.04)	0.20 (0.15)
Liquid assets to total assets	-0.03*** (0.01)	-0.65* (0.37)	-0.06*** (0.01)	0.04** (0.02)	-0.24 (0.44)	-0.92 (0.90)	0.23 (0.17)	-0.62 (0.55)
Log of total assets	-0.44*** (0.07)	-10.41*** (3.38)	-0.76*** (0.08)		-10.09*** (3.55)		-3.35*** (1.00)	-7.09*** (2.35)
Foreign Bank Dummy	-0.74*** (0.26)	-14.00 (11.83)	-0.77*** (0.23)		-18.96 (12.45)		1.02 (0.66)	-2.31 (2.42)
U.S. inflation rate	0.66*** (0.06)	-0.77 (2.34)	0.26*** (0.05)		-1.43 (2.83)		-0.78 (0.61)	-0.78 (1.21)
Growth rate of real GDP in Bolivia	0.18*** (0.03)	-2.04 (1.37)	0.07** (0.03)		-1.92 (1.44)		0.01 (0.33)	-1.52 (1.42)
Political instability dummy	0.32** (0.14)	-6.02 (5.49)	0.39*** (0.12)		-8.37 (5.59)		0.02 (1.67)	-6.75** (3.03)
Observations	842	863	842		863		801	831
R-Square	0.76	0.15	0.83		0.17		0.11	0.13

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table VIII
Sensitivity analysis

Panel 1 uses a sub-sample for which the number of foreign banks is equal to the number of domestic banks. Panel 2 investigates whether domestic and foreign banks are subject to different degrees of market discipline. The standard errors, in parentheses, are corrected for heteroskedasticity. The columns “DI effect” (“Foreign”) show the coefficients of the interaction terms between the deposit insurance dummy variable (foreign bank dummy variable) and indicators of bank risk.

	Panel 1				Panel 2			
	Interest Rates		Deposits		Interest Rates		Deposits	
		DI effect		DI effect		Foreign		Foreign
Leverage ratio	-0.12*** (0.01)	0.09*** (0.01)	2.75** (1.34)	-1.45 (1.12)	-0.14*** (0.02)	0.10*** (0.02)	1.60** (0.79)	-1.61 (1.07)
Nonperforming loans to total assets	0.01 (0.03)	-0.02 (0.03)	-5.23*** (1.76)	4.37*** (1.70)	0.03 (0.03)	0.02 (0.03)	-2.39*** (0.57)	2.01*** (0.44)
Loan loss reserves to total assets	-0.38*** (0.05)	0.33*** (0.05)	8.86*** (3.01)	-8.54*** (2.76)	-0.46*** (0.05)	0.25*** (0.05)	1.80** (0.79)	-1.18** (0.59)
Overhead expenses to total assets	2.53*** (0.43)	-1.58*** (0.48)	-55.66*** (18.12)	53.54*** (21.82)	2.98*** (0.30)	-1.48*** (0.38)	-30.26*** (9.44)	23.69* (14.40)
Return to total assets	0.03 (0.02)	-0.04** (0.02)	0.82 (0.76)	-0.81 (0.77)	-0.03 (0.02)	0.03 (0.02)	0.19 (0.20)	-0.19 (0.25)
Liquid assets to total assets	-0.07*** (0.01)	0.07*** (0.01)	-1.21 (1.04)	0.90 (1.20)	-0.01 (0.01)	-0.02 (0.01)	-0.81 (0.71)	1.26 (0.91)
Foreign bank dummy	-0.17* (0.10)		-4.75 (3.12)		-1.83*** (0.29)		-10.04* (5.75)	
Log of total assets	-0.81*** (0.08)		-1.98 (2.89)		-0.52*** (0.69)		-5.14** (2.44)	
U.S. inflation rate	0.23 (0.09)		1.48 (2.24)		0.54*** (0.06)		0.17 (1.15)	
Growth rate of real GDP in Bolivia	0.01 (0.06)		-4.10 (3.15)		0.06* (0.03)		-1.56 (1.65)	
Political instability dummy	0.47*** (0.15)		-8.44*** (3.12)		0.22 (0.16)		-6.78*** (2.68)	
Observations	594		587		842		863	
R-Square	0.82		0.19		0.78		0.13	

***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Figure 1
Market discipline and reduced-form models

This figure describes four possible scenarios of shifts in the demand and supply of deposits after an increase in bank risk, assuming that both supply and demand depend on bank risk. i , d , and $*$ denote interest rate on deposits, volume of deposits, and equilibrium measures, respectively.

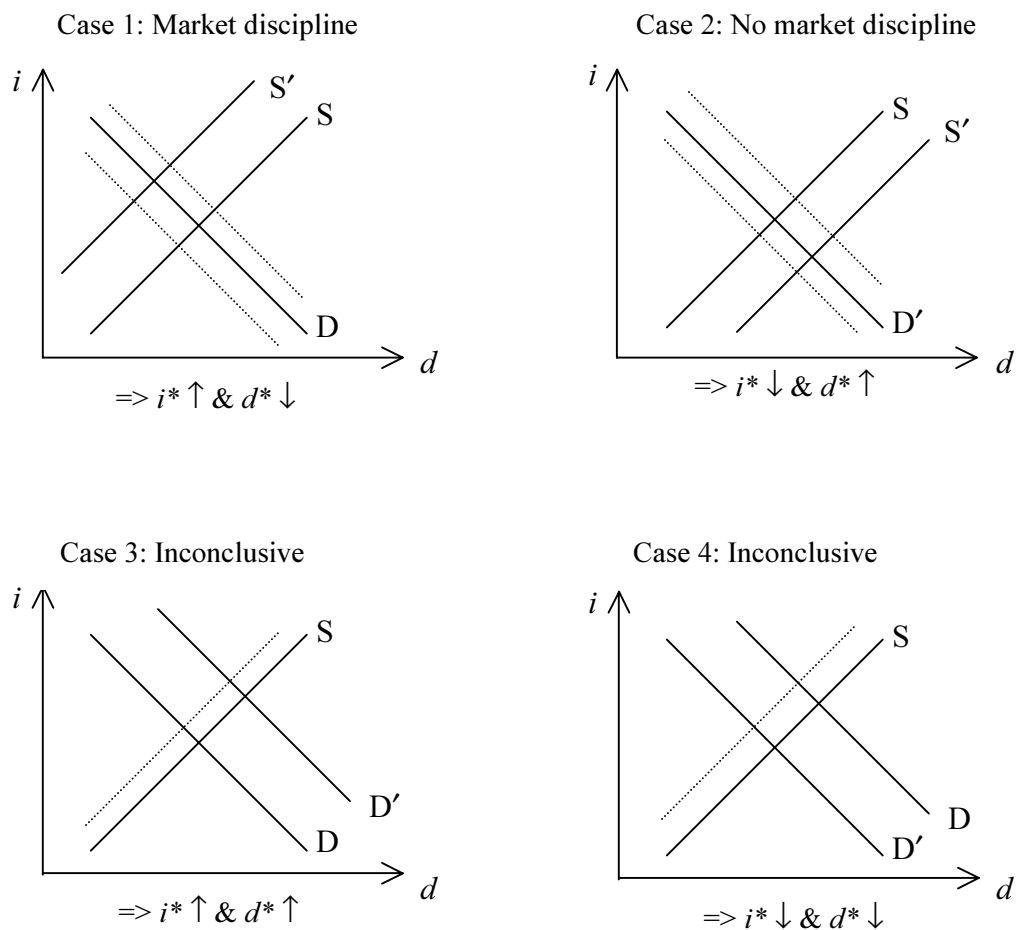
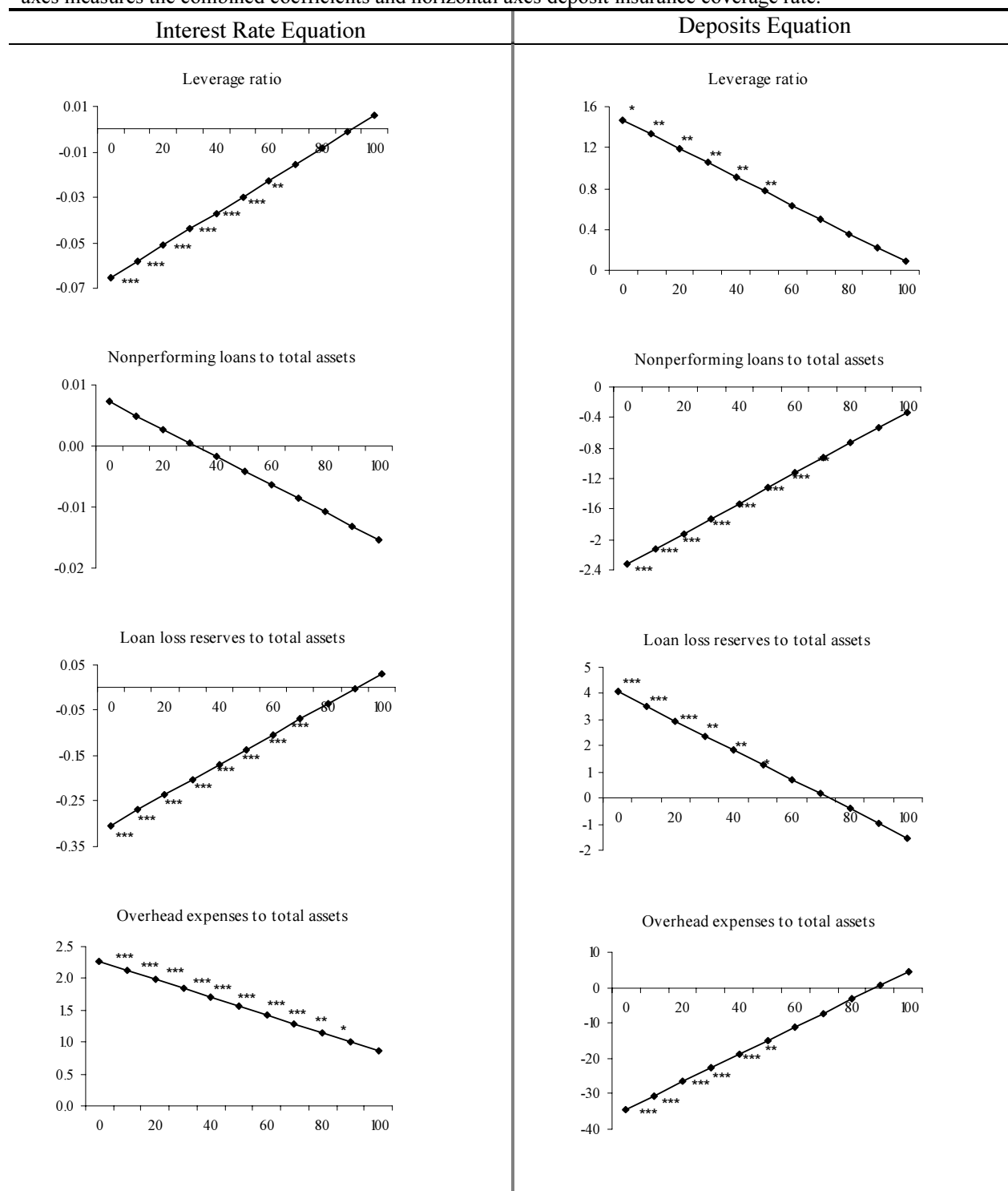


Figure 2
Market discipline and deposit insurance coverage rates

This figure describes the sensitivity of interest rates and deposits on bank risk for different values of deposit insurance coverage. These estimates have been calculated using estimates from Table IV, panel 2. The vertical axes measures the combined coefficients and horizontal axes measures deposit insurance coverage rate.



***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.